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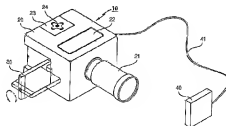
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(54) Title: PORTABLE X-RAY APPARATUS



(57) Abstract: A portable X-ray apparatus comprises a main body, a power source unit for applying power to the main body, an input unit for setting and selectively inputting operation functions of the main body, a display unit for displaying the operation functions of the main body and a function selected by a user, and an image capturing unit provided at one side of the main body and capturing an image of an inspection-subjected person, the apparatus comprising: an image output unit provided at one side of the main body; a reaction sensor separated from the main body with a certain distance therebetween, reacting to X-ray irradiated from the image capturing unit, and transmitting a reaction signal; and a controller disposed within the main body to control the operation functions of the main body, and converting the reaction signal transmitted from the reaction sensor into an image signal and storing it, wherein an image captured by irradiating X-ray to the inspection-subjected person is outputted by using the image output unit to immediately check (examine) the obtained X-ray image of the inspection-subjected person. Thus, the portable X-ray apparatus can be simply transported to a patient or an inspection-subjected person who is not movable for some physical problems, to a mountainous or remote area, or to an area where a patient cannot be benefited from a medical treatment because of a lack of a medical institution, so that the X-ray operation can be simply and easily performed on the patient or the inspection-subjected person, and after X-ray is irradiated to the inspection-subjected person by using the X-ray apparatus, since images can be captured and examined without using an additional medium such as a computer, installation of the medium is not necessary and the operation is easy. In addition, since the portably X-ray apparatus is small, it can be easily transported, and images of the inspection-subjected person can be captured and examined immediately by using the X-ray apparatus itself.

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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

## **Description**

### **PORTABLE X-RAY APPARATUS**

#### **Technical Field**

- [1] The present invention relates to a medical equipment and, more particularly, to a portable X-RAY apparatus capable of being easily transportable and carried around and thus immediately capturing and producing an image of a patient or an X-ray operation target (referred to hereinafter as an 'inspection-subjected person') to perform a medical examination on a condition of the inspection-subjected person.

[2]

#### **Background Art**

- [3] In general, the X-ray apparatus, the medical equipment used in a medical institution such as a medical office or a hospital, irradiates X-ray to the inspection-subjected person, detects X-ray transmitted through the inspection-subjected person, and produces a corresponding image to thereby examine an internal condition of the inspection-subjected person.
- [4] The related art X-ray apparatus is generally located in the medical institution and performs an examination on the inspection-subjected person, and as such it is considerably bulky, heavy and high-priced.
- [5] Thus, conventionally, a medical team of the medical office or the medical institution carries the X-ray apparatus in a large vehicle (e.g., a large bus) to transport it to outside to perform X-ray operation and simple examination, and then, a large medical institution performs a suitable medical treatment based on obtained data.
- [6] However, the related art method is disadvantageous in that results of the X-ray operation and examination are not obtained immediately, and because an X-ray film is used for X-ray operation, the film needs to be developed by using a film developer, which causes time consumption and user inconvenience.
- [7] In addition, transportation of the X-ray apparatus to outside is not easy, and when the apparatus is not properly handled during the transportation, the high-priced apparatus could be damaged.
- [8] Due to the problems, if a patient lives in a mountainous or remote area or in an area where he/she cannot be benefited from a medical treatment because of a lack of a medical institution, he/she would miss a proper treatment time, which increases the economical and mental burden of the patient himself/herself or the family members of the patient.
- [9] In order to solve the problems, in a Korean Patent Laid Open Publication No. 2002-8810 entitled 'Portable digital X-ray system', which comprises an X-ray

generation device 100, an X-ray detection device 200 and a support 300 detachably coupled thereto, discloses the following techniques. The X-ray generation device 100 comprises a coupling recess (not shown) at its outer circumferential surface so as to be attached to or detached from the support 300 and irradiates X-ray. The X-ray detection device 200 comprises X-ray phosphor 210 formed at a certain area and reacted to the X-ray irradiated from the X-ray generation device 100 to convert it into visible light, and a transmission unit 240 for converting light generated from the X-ray phosphor 210 into a digital image signal and storing it, and transmitting the digital image signal. The support 300 comprises a coupling member 305 to be attached to or detached from the coupling recess (not shown) of the X-ray generation device 100, and supports the X-ray generation device 100. In addition, a computer 400 is electrically connected with the X-ray detection device 200, receives the digital image signal stored in the X-ray detection device 200 in real time and displays it as an image on its screen.

[10] The portable digital X-ray system, however, is disadvantageous in that after X-ray is irradiated to an inspection-subjected person by using the digital X-ray system, a corresponding image must be transmitted to the computer for checking of it, so the system is not available without the computer or if the computer is broken down.

[11] In addition, the total volume of the X-ray system is relatively bulky, and in order to use the X-ray system, so many elements such as the support or the computer are needed to be installed, which makes the operation complicate and the X-ray system easily broken down.

[12]

## **Disclosure of Invention**

### **Technical Problem**

[13] Therefore, the present invention is designed to solve the problem of the related art, and therefore, one object of the present invention is to provide a portable X-ray apparatus capable of checking an image by itself without using any other medium such as a computer after irradiating X-ray to an inspection-subjected person.

[14] Another object of the present invention is to provide a portable X-ray apparatus capable of facilitating user's transportation owing to its small volume, and capturing an image of an inspection-subjected person and simply checking the image immediately (on the spot) by the apparatus itself.

[15]

### **Technical Solution**

[16] To achieve the above objects, there is provided a portable X-ray apparatus according to a first aspect of the present invention, which comprises a main body, a power source unit for applying power to the main body, an input unit for setting and

selectively inputting operation functions of the main body, a display unit for displaying the operation functions of the main body and a function selected by a user, and an image capturing unit provided at one side of the main body and capturing an image of an inspection-subjected person, the apparatus comprising: an image output unit provided at one side of the main body; a reaction sensor separated from the main body with a certain distance therebetween, reacting to X-ray irradiated from the image capturing unit, and transmitting a reaction signal; and a controller disposed within the main body to control the operation functions of the main body, and converting the reaction signal transmitted from the reaction sensor into an image signal and storing it, wherein an image captured by irradiating X-ray to the inspection-subjected person is outputted by using the image output unit to immediately check (examine) the obtained X-ray image of the inspection-subjected person.

- [17] The image output unit is mounted at the main body so as to be rotatable by virtue of a rotational shaft.
- [18] The image output unit is outwardly protruded by virtue of the rotational shaft in its use, and can be rotated by 360 degrees centering on the rotational shaft.
- [19] A compact flash (CF) card for storing the image signal may be comprised in the controller.
- [20] The power source unit includes a plurality of high voltage condensers and high voltage diodes, and when power is supplied, the power is increased by the high voltage diodes to generate radio frequencies, whereby the main body can irradiate X-ray through the image capturing unit.
- [21] The input unit can control the X-ray image of the inspection-subjected person such that the X-ray image can be scaled up to the entire region or scaled down to a specific region so as to be displayed onto the image output unit.
- [22] A handle or a handle strap is additionally provided at the other side of the main body to enhance portability and facilitate transportation and image capturing.
- [23] To achieve the above objects, there is also provided a portable X-ray apparatus according to a second aspect of the present invention in which the image capturing unit is detachably mounted at the main body.
- [24] To achieve the above objects, there is also provided a portable X-ray apparatus according to a third aspect of the present invention in which the image capturing unit is formed in a multi-stage configuration, and an end of the image capturing unit is folded to be inserted into the main body so that the main body can be easily kept in storage or can be conveniently transported.
- [25] To achieve the above objects, there is also provided a portable X-ray apparatus according to a fourth aspect of the present invention, the image output unit is mounted inside the main body, is externally protruded in a slidable manner in its use, and is

rotatable by 360 degrees by an axis centering on a direction in which the image output unit is protruded.

[26]

### **Advantageous Effects**

[27] As described above, the portable X-ray apparatus in accordance with the present invention has many advantages.

[28] That is, the portable X-ray apparatus can be simply transported to a patient or an inspection-subjected person who is not movable for some physical problems, to a mountainous or remote area, or to an area where a patient cannot be benefited from a medical treatment because of a lack of a medical institution, so that the X-ray operation can be simply and easily performed on the patient or the inspection-subjected person.

[29] In addition, after X-ray is irradiated to the inspection-subjected person by using the X-ray apparatus, images can be captured and examined without using an additional medium such as a computer, so installation of the medium is not necessary and the operation is easy.

[30] Moreover, since the portably X-ray apparatus is small, it can be easily transported, and images of the inspection-subjected person can be captured and examined immediately by using the X-ray apparatus itself.

[31]

### **Brief Description of the Drawings**

[32] FIG. 1 is a perspective view of a portable X-ray apparatus in accordance with one embodiment of the present invention.

[33] FIG. 2 is a perspective view showing that an image output unit of the portable X-ray apparatus of FIG. 1 is in a closed state.

[34] FIG. 3 is a perspective view showing that the image output unit of the portable X-ray apparatus of FIG. 1 is in an opened state.

[35] FIG. 4 shows a screen of a display unit when the portable X-ray apparatus is driven (operated) in accordance with the present invention.

[36] FIG. 5 shows a screen for setting an irradiation time when an X-ray irradiation mode is selected.

[37] FIG. 6 shows a screen of the display unit when a driving setting and image checking mode is selected.

[38] FIG. 7 shows a screen for setting contrast/brightness.

[39] FIG. 8 is a perspective view of a portable X-ray apparatus in accordance with another embodiment of the present invention.

[40]

## Best Mode for Carrying Out the Invention

- [41] A portable X-ray apparatus in accordance with the present invention will now be described with reference to the accompanying drawings. The drawings are merely exemplary ones and the present invention is not limited thereto. Herein, a description for FIG. 2 in which an image output unit is provided at one side of a main body will be omitted because its description can be comprised in the description of an embodiment as described below in which the image output unit is rotated and externally exposed from the main body.
- [42] FIG. 1 is a perspective view of a portable X-ray apparatus in accordance with one embodiment of the present invention, and FIG. 3 is a perspective view showing that the image output unit of the portable X-ray apparatus of FIG. 1 is in an opened state.
- [43] With reference to FIGs. 1 to 3, a portable X-ray apparatus 10 in accordance with the present invention comprises an image capturing unit 21 protrusively formed at its front side, and a reaction sensor 40 connected with the main body 20 with a certain distance therebetween by an electric cord.
- [44] A display unit 22 and an input unit 23 are provided at an upper end surface of the main body 20.
- [45] An image output unit 30 is mounted to be rotatable by virtue of a rotational shaft 31 provided at one side surface of the main body 20. When the image output unit 30 is to be used, it is externally taken out as shown in FIG. 3. When a user performs an X-ray operation by using the portable X-ray apparatus 10, he/she can rotate the image output unit 30 to be externally exposed and takes images of an inspection-subjected person therethrough while looking at the inspection-subjected person.
- [46] Herein, the image output unit 30 is constructed such that it can be freely rotated by 360 degrees according to several postures of the user, for example, that the user may raise his/her arms or let his/her arms down to be posed almost on the bottom in using the portable X-ray apparatus. Accordingly, the user can conveniently take images while looking at the image output unit 30.
- [47] The input unit 23 comprises a power button (not shown) and an input button 24. The input button 24 includes total five buttons comprising toggle type buttons positioned at left/right and up/down portions therein and a select button positioned at the central portion thereof. Preferably, the input button 24 is a navigation button.
- [48] In the portable X-ray apparatus 10 in accordance with the present invention, every operation of the main body 20 can be controlled solely by the input button 24.
- [49] Though not shown, it is preferred that a handle or a handle strap is provided at one side of the main body 20 to make the user easily carry around or use the portable X-ray apparatus.

- [50] The power source unit (not shown) comprises a plurality of high voltage condensers (not shown) and a plurality of high voltage diodes (not shown), so that when power is supplied, the power can be increased by the high voltage diodes to generate high frequencies, whereby X-ray can be irradiated to the inspection-subjected person by using the portable X-ray apparatus 10. In this case, as the power source of the power supplied to the power source unit, a portable battery can be used, and power can be applied from outside by using a typical power line.
- [51] The reaction sensor 40 provided at a certain distance from the main body 20 has such a size as to be put into the mouth of the inspection-subjected person and is connected with the main body 20 by the electric cord. In this case, the reaction sensor 40 can be made of an elastic material.
- [52] With the reaction sensor 40 fixedly put inside the mouth of the inspection-subjected person, when the image capturing unit 21 is placed in front of the inspection-subjected person and irradiates X-ray toward the reaction sensor 40, the reaction sensor 40 is reacted to the irradiated X-ray and transmits a reaction signal to the main body 20. Then, the main body 20 converts the received signal into an image signal and outputs it to the image output unit 30.
- [53] FIG. 4 shows a screen of a display unit when the portable X-ray apparatus is driven (operated) in accordance with the present invention, FIG. 5 shows a screen for setting an irradiation time when an X-ray irradiation mode is selected, FIG. 6 shows a screen of the display unit when a driving setting and image checking mode is selected, and FIG. 7 shows a screen for setting contrast/brightness.
- [54] As shown in FIGs. 4 to 7, by using the input button 24 positioned at the upper end surface of the main body 20, the X-ray irradiation mode and the driving setting and image checking mode can be selected, the X-ray irradiation time can be controlled, the contract/brightness can be set, and an image or a photo stored in the storage unit can be reviewed or deleted.
- [55] First, when the portable X-ray apparatus 10 in accordance with the present invention is driven by pressing the power button (not shown), the X-ray irradiation mode and the driving setting and image checking mode as shown in FIG. 4 are displayed to allow the user to select one of the modes.
- [56] With reference to FIG. 5, when the user selects the X-ray irradiation mode, the X-ray irradiation time is set. In this case, in the present invention, the X-ray irradiation time is selectively set in the range of 0.02 sec ~ 0.2 sec, and 0.02 sec can be added or subtracted whenever the input button 24 is pressed up and down or left and right. Herein, the X-ray irradiation time can be set differently according to a situation of the user or the inspection-subjected person.
- [57] With the X-ray irradiation time set, the user starts capturing images by using the



image capturing unit 21 while looking at the inspection-subject person through the image output unit 30, and the taken photos or captured images can be immediately checked through the image output unit 30 in the driving setting and image checking mode.

- [58] With reference to FIG. 6, when the user selects the driving setting and image checking mode, a mode (Cont.Brt.) for changing setting (Contrast/Brightness) of the main body 20, a mode (Rotation) for viewing again a photo or an image which has been previously captured and stored in the storage unit, a mode (Image Del) for deleting the stored photo or image, and a mode (Return) for returning to a previous screen are displayed on the display unit 22.
- [59] The modes can be shifted and selected by pressing the up/down left/right and select buttons of the input button 24 positioned at the upper end surface of the main body 20, and when the user selects the mode (Rotation) for viewing again a photo or an image, photos or images are displayed in turn starting from the latest photo or image. In this case, preferably, a capture date and time are displayed when the stored photos or images are checked.
- [60] Though not shown, when a photo or an image just captured by the image capturing unit or the photos or images previously stored in the storage unit are viewed through the image output unit 30, the entirety or a specific portion of the photo or the image can be scaled up or down by using the input button 24, so that the user can surely examine the captured photo or image of the inspection-subjected person.
- [61] With reference to FIG. 7, the contrast/brightness (Cont./Brt.) setting screen for setting saturation (strong and dark) and brightness (degree of definition) comprises a contrast vertical bar and a brightness vertical bar. The user can shift to the contrast setting or the brightness setting by using the left and right buttons of the input button 24, and set contrast/brightness by using the up and down buttons of the input button 24.
- [62] FIG. 8 is a perspective view of a portable X-ray apparatus in accordance with another embodiment of the present invention.
- [63] With reference to FIG. 8, unlike the image output unit 30 as shown in FIGs. 2 and 3, in this embodiment of the present invention, the image output unit 30 is mounted inside the main body 20. The image output unit 30 can be externally protruded slidably by pulling out a handle (not shown) formed at an end of the image output unit 30. Like the image output unit as shown in FIG. 2, the image output unit 30 can be rotatable by 360 degrees according to postures of the user.
- [64] In the case where the image output unit 30 is mounted in the sliding manner, preferably, a coupling member (not shown) for fixing the image output unit 30 is provided inside the main body 20.

[65] In the present invention, though the image capturing unit is fixedly formed at the front side of the main body, the image capturing unit can be also formed in a multi-stage configuration so that it can be folded into the main body when being carried around or kept in storage.

[66] The foregoing description of the preferred embodiments of the present invention has been presented for the purpose of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed, and modifications and variations are possible in light of the above teachings or may be acquired from practice of the invention. It is intended that the scope of the invention be defined by the claims appended hereto and their equivalents.

[67]

### **Industrial Applicability**

[68] The CF card is used as a storage unit in the present invention, which is widely employed for compact electronic products such as a digital camera with its excellent compatibility.

[69] The portable X-ray apparatus can be commonly used for the purpose of dental treatment. In this case, the reaction sensor electrically connected with the main body can be put into the mouth of a patient, X-ray is can be irradiated to the reaction sensor to take an image of the teeth of the patient, and then the taken image can be outputted through the image output unit.

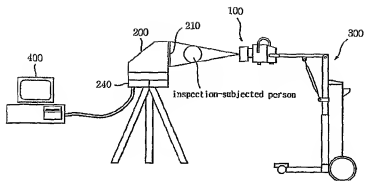
[70]

## Claims

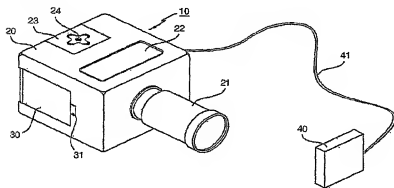
- [1] A portable X-ray apparatus which comprises a main body, a power source unit for applying power to the main body, an input unit for setting and selectively inputting operation functions of the main body, a display unit for displaying operation functions of the main body and a function selected by a user, and an image capturing unit provided at one side of the main body and capturing an image of an inspection-subjected person, the apparatus comprising: an image output unit provided at one side of the main body; a reaction sensor separated from the main body with a certain distance therebetween, reacting to X-ray irradiated from the image capturing unit, and transmitting a reaction signal; and a controller disposed within the main body to control the operation functions of the main body, and converting the reaction signal transmitted from the reaction sensor into an image signal and storing it, wherein an image captured by irradiating X-ray to the inspection-subjected person is outputted by using the image output unit to immediately check the obtained X-ray image of the inspection-subjected person.
- [2] The apparatus of claim 1, wherein the image output unit is mounted at the main body so as to be rotatable by virtue of a rotational shaft.
- [3] The apparatus of claim 2, wherein the image output unit is outwardly protruded by virtue of the rotational shaft in its use, and can be rotated by 360 degrees centering on the rotational shaft.
- [4] The apparatus of one of claim 1 to 3, wherein a compact flash (CF) card for storing the image signal is included in the controller.
- [5] The apparatus of claim 4, wherein the power source unit comprises a plurality of high voltage condensers and high voltage diodes, and when power is supplied, the power is increased by the high voltage diodes to generate radio frequencies, so that the main body can irradiate X-ray through the image capturing unit.
- [6] The apparatus of claim 5, wherein the input unit can control the X-ray image of the inspection-subjected person such that the X-ray image can be scaled up to the entire region or scaled down to a specific region so as to be displayed onto the image output unit.
- [7] The apparatus of claim 7, wherein a handle or a handle strap is additionally provided at the other side of the main body to enhance portability and facilitate transportation and image capturing.
- [8] The apparatus of claim 7, wherein the image capturing unit is detachably mounted at the main body.

- [9] The apparatus of claim 7, wherein the image capturing unit is formed in a multi-stage configuration, and an end of the image capturing unit is folded to be inserted into the main body so that the main body can be easily kept in storage or can be conveniently transported.
- [10] The apparatus of claim 1, wherein the image output unit is mounted inside the main body, is externally protruded in a slidable manner in its use, and is rotatable by 360 degrees by an axis centering on a direction in which the image output unit is protruded.

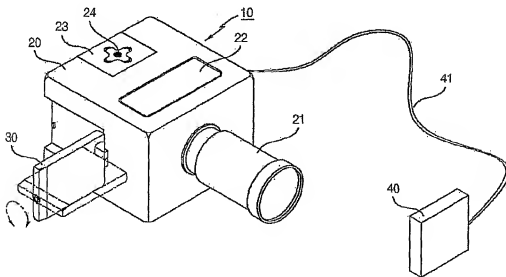
[Figure 1]



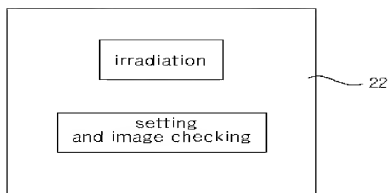
[Figure 2]



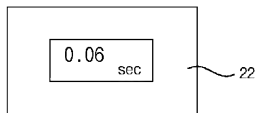
[Figure 3]



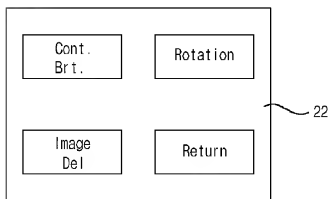
[Fig. 4]



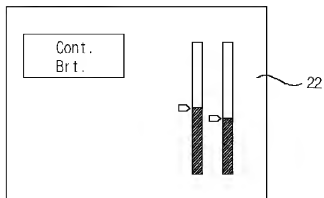
[Fig. 5]



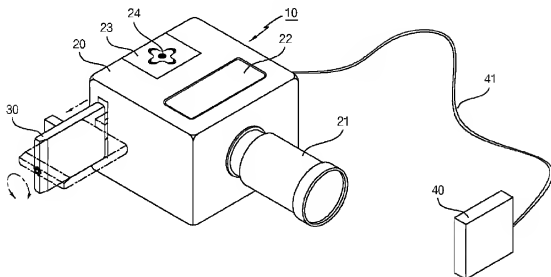
[Fig. 6]



[Fig. 7]



[Fig. 8]



## INTERNATIONAL SEARCH REPORT

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PCT/KR2005/004185**A. CLASSIFICATION OF SUBJECT MATTER***A61B 6/00(2006.01)i*

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

A61B 6/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 07-246199 A(TOSHIBA Co.) SEPTEMBER 26, 1995 see the whole document	1-10
Y	JP 11-104117 A(CHUNICHI DENKI Co.) APRIL 20, 1999 see the whole document	1-10

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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Date of the actual completion of the international search

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Date of mailing of the international search report

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